

REMARKS

This paper is responsive to any paper(s) indicated above, and is responsive in any other manner indicated below.

PENDING CLAIMS

Claims 1-15 were pending in the application. Appropriate claims have been amended, canceled and/or added (without prejudice or disclaimer) in order to adjust a clarity and/or focus of Applicant's claimed invention. That is, such changes are unrelated to any prior art or scope adjustment and are simply refocused claims in which Applicant is present interested. At entry of this paper, Claims 1-6 and 10-25 will be pending for further consideration and examination in the application.

REJECTION(S) UNDER 35 USC '103

The 35 USC '103 rejection is respectfully traversed. However, such rejections have been rendered obsolete by the present clarifying amendments to Applicant's claims, and accordingly, traversal arguments are not appropriate at this time. However, Applicant respectfully submits the following to preclude renewal of any such rejections against Applicant's clarified claims.

All descriptions of Applicant's disclosed and claimed invention, and all descriptions and rebuttal arguments regarding the applied prior art, as previously submitted by Applicant in any form, are repeated and incorporated hereat by reference. Further, all Office Action statements regarding the prior art rejections are respectfully traversed. As additional arguments, Applicant respectfully submits the following initial arguments from Applicant's foreign patent representative.

The Examiner still repeats the obviousness rejection of all apparatus claims 1-6 and 10-15 relying on the combination of Kagoshima et al and Rauf et al "Modeling the Impact of Photoresist Process Trim Etch Process On Photoresist Surface Roughness" which is referenced in the present specification. Particularly, Applicants note the Examiner's repetition of his comment stating page 3, lines 3-6, esp. lines 5-6 "Shahid Rauf et al have extensively studied dependence of etch rate upon roughness (undulation) when all other factors remain same. They teach that the etch rate is high at the beginning if the initial roughness is high, and reduces when the roughness is reduced. So that it is essential to (a) know the initial roughness in order to (b) estimate etch time needed to etch to target CD."

Applicant respectfully counters that Rauf et al, however, does not disclose the above-underlined portions (a) and (b) anywhere. The underlined portions are mere groundless assumptions by the Examiner without corroboration. If the Examiner disagree, Applicant respectfully requests that the relevant portions in the Rauf et al publication should be pointed out by the Examiner to Applicants.

In continuing discussions, Fig.1 of Rauf et al merely gives the definition of roughness as an unevenness expressed by R. Fig. 4 shows that the rate of roughness reduction changes with time, that is, the degree of unevenness decreases as the etch time increases. As to the correlation between the roughness and the etch time Rauf refers to the degree of surface roughness, whereas Applicants invention relates to the degree of line edge roughness. Thus, this invention differs from Rauf et al in objects to be processed.

As additional arguments, the Examiner's comments in the office action, page 4, lines 12-13 are traversed for the following reasons:

Choo et al. (USP6,516,528) discloses that line edge roughness may be employed to adjust operating characteristics as pointed out, but it relates to lithographical technologies and has no relation with roughness of a mask which is the case of this invention. Choo merely indicates a general teaching about roughness measurement.

Hays (US2003/0108235), paragraph [0007] discloses that control of semiconductor wafer processes has evolved to include characteristics of profile as a part of critical dimension specification, as pointed out by the Examiner. However, Hays merely discloses a general teaching of three-dimensional roughness measurement taking a physical cross section which is important for the roughness as in Rauf et al.

However, Rauf et al. and Hays do not refer to the relation between the roughness reduction and the target CD.

In contrast and advantageously, Applicants' invention refers to the essentiality of the initial condition of roughness (edge undulation), which will influence the CD or width dimension of a patterned mask (refer to obtaining of a critical width B shown in Fig.3 by trimming).

Therefore, any of Rauf et al., Choo and Hays is not applicable or particularly relevant to the claimed invention. Applicant's claims, thus, of course, would not be obvious from combination of Kagoshima and Rauf et al for the reasons already stated as well as argued above.

Regarding independent claim 10, and also added dependent claims 16-17, such claims further clarify a difference from Kagoshima, because Kagoshima does not explicitly disclose the measuring/using of an ion amount.

In addition to the foregoing, the following additional remarks from the Undersigned are also submitted in support of traversal of the rejection and patentability of Applicant's claims.

Added claims 18 and 20-50 substantially parallel claims 10-15 and 17, respectively, but use different terminology and include greater detailed limitations. More particularly, added independent claim 18 such claim recites (in relevant part), "trimming condition calculating means for automatically calculating a trimming condition including trimming timing required for said trimming treatment to obtain a desired mask width by taking into consideration a pre-measured width dimension of said patterned mask and a pre-measured amount of line edge corrugation extending along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge; wherein the trimming treatment is carried out for the trimming condition including the trimming timing, calculated by said trimming condition calculating means."

Support for use of the "corrugation", "protrusion amount" and "protrusion width" limitations can be found within Applicant's original specification, for example, at pages 14-15 and also see Applicant's FIGS. 3, 5A-C, 6 and 10A-B. Further, it is respectfully noted that Websters II New College Dictionary, copyright 1999, at page 254, defines "corrugation" as "The state of being corrugated", and defines

“corrugate” as “To form or become formed into folds or parallel and alternating ridges and grooves.”

Turning now to rebuttal of the applied art, the cited Rauf et al. article’s model (discussed within Rauf et al.) only concerns generalized surface roughness, and specifically excludes (see page 656, right column, ending lines of paragraph which begins as “Experiments have shown...”) “vertical striations” (analogous to Applicant’s “corrugations”). Accordingly, it is respectfully submitted that Rauf et al. nowhere discloses Applicant’s arrangement using “a pre-measured amount of line edge corrugation extending along vertical mask sidewalls, ..., wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge; wherein the trimming treatment is carried out for the trimming condition including the trimming timing, calculated by said trimming condition calculating means.”

That is, Rauf et al.’s taught generalized surface roughness is vastly different from Applicant’s “line edge corrugation” features. None of the other references cure this major deficiency with respect to the Rauf et al. reference.

Continuing, added claim 19 recites, “wherein the trimming condition calculating means automatically calculating the trimming condition including both a line edge corrugation trimming time and a mask proper trimming time, wherein the line edge corrugation trimming time is directed to lessening the amount of the line edge corrugation of the patterned mask, and the mask proper trimming

time is directed to lessening a width of a major body of the patterned mask;
and wherein the trimming treatment is carried out for the trimming condition
including the line edge corrugation trimming time and the mask proper
trimming time, calculated by said trimming condition calculating means.” Support
for such timings may be found within Applicant’s specification beginning at page 15,
line 22 through page 16, last line.

Again rebutting the Rauf et al. reference, such reference is deficient in not
teaching the separate timings utilized within Applicant’s claimed trimming condition.
Especially given the fact that Rauf et al. does not address line edge corrugation.
None of the other references cure this major deficiency with respect to the Rauf et al.
reference.

As a result of all of the foregoing, it is respectfully submitted that the applied
art (taken alone and in the Office Action combinations) would not support a '103
obviousness-type rejection of Applicant's claims. Accordingly, reconsideration and
withdrawal of such '103 rejection, and express written allowance of all of the '103
rejected claims, are respectfully requested.

EXAMINER INVITED TO TELEPHONE

The Examiner is herein invited to telephone the undersigned attorneys at the
local Washington, D.C. area telephone number of 703/312-6600 for discussing any
Examiner’s Amendments or other suggested actions for accelerating prosecution
and moving the present application to allowance.

RESERVATION OF RIGHTS

It is respectfully submitted that any and all claim amendments and/or cancellations submitted within this paper and throughout prosecution of the present application are without prejudice or disclaimer. That is, any above statements, or any present amendment or cancellation of claims (all made without prejudice or disclaimer), should not be taken as an indication or admission that any objection/rejection was valid, or as a disclaimer of any scope or subject matter. Applicant respectfully reserves all rights to file subsequent related application(s) (including reissue applications) directed to any/all previously claimed limitations/features which have been subsequently amended or cancelled, or to any/all limitations/features not yet claimed, i.e., Applicant continues (indefinitely) to maintain no intention or desire to dedicate or surrender any limitations/features of subject matter of the present application to the public.

CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully submits that the claims listed above as presently being under consideration in the application are now in condition for allowance.

To the extent necessary, Applicant petitions for an extension of time under 37 CFR '1.136. Authorization is herein given to charge any shortage in the fees, including extension of time fees and excess claim fees, to Deposit Account No. 01-2135 (Case No. 500.43597X00) and please credit any excess fees to such deposit account.

Based upon all of the foregoing, allowance of all presently-pending claims is respectfully requested.

Respectfully submitted,

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